Appendix A

Work Plan for the Collection of Eggs from Spotted Sandpipers, American Woodcock, Belted Kingfisher, American Robin, Red-Winged Blackbird and Eastern Phoebe Associated with the Hudson River from Hudson Falls to Schodack Island, New York

WORK PLAN FOR THE COLLECTION OF EGGS FROM SPOTTED SANDPIPERS, AMERICAN WOODCOCK, BELTED KINGFISHER, AMERICAN ROBIN, RED-WINGED BLACKBIRD AND EASTERN PHOEBE ASSOCIATED WITH THE HUDSON RIVER FROM HUDSON FALLS TO SCHODACK ISLAND, NEW YORK

HUDSON RIVER NATURAL RESOURCE DAMAGE ASSESSMENT

HUDSON RIVER NATURAL RESOURCE TRUSTEES

STATE OF NEW YORK

U.S. DEPARTMENT OF COMMERCE

U.S. DEPARTMENT OF THE INTERIOR

FINAL
PUBLIC RELEASE VERSION*

MARCH 2002

Available from:
U.S. Department of Commerce
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Hudson River NRDA, Lead Administrative Trustee
Damage Assessment Center, N/ORR31
1305 East-West Highway, Rm 10219
Silver Spring, MD 20910-3281

**Names of certain individuals and affiliations have been removed to maintain confidentiality*

ERRATA

to

Work Plan for the Collection of Eggs from Spotted Sandpipers, American Woodcock, Belted Kingfisher, American Robin, Red-Winged Blackbird, and Eastern Phoebe Associated With the Hudson River from Hudson Falls to Schodack Island, New York

In Section 1.0, Introduction, S E A Consultants, Inc. (2001) should be cited as S E A Consultants (2002):

> S E A Consultants, Inc. 2002. Hudson River Natural Resources Damage Assessment, Floodplain Soil and Biota Screening Sampling Report. S E A Consultants, Inc., Cambridge, Mass. Report Prepared for Industrial Economics, Inc. S E A Project No. 2000416.01-A.

In section 1.2.1.1, Drouillard and Norstrom 2001a should be Drouillard and Norstrom 2000 and the citation for the reference in section 7.0, Literature Cited, should be as follows:

> Drouillard, K.G. and R. Norstrom. 2000. Dietary absorption efficiencies and toxicokinetics of polychlorinated biphenyls in ring doves following exposure to Aroclor mixtures. *Environ. Toxicol. & Chem.* 19(11):2707-2714.

In section 1.2.1.1, Drouillard and Norstrom 2001b should be Drouillard and Norstrom 2001 and the citation for the reference in Section 7.0, Literature Cited, should be as follows:

> Drouillard, K.G. and R. Norstrom. 2001. Quantifying maternal and dietary sources of 2,2',4,4',5,5'-hexachlorobiphenyl deposited in eggs of the ring dove (*Streptopelia risoria*). *Environ. Toxicol. & Chem.* 20:561-567.

In section 1.2.1.1, “Peakell and Peakell 1973” should be “Peakall and Peakall 1973” and the citation for the reference in section 7.0, Literature Cited, should be as follows:

> Peakall, D.B. and M.L. Peakall. 1973. Effects of polychlorinated biphenyl on the reproduction of artificially and naturally incubated dove eggs. *Journal of Applied Ecology* 10:863-868.

Also in section 7.0 the citation for Arena et al. 1999 should be as follows:

> Arena, S. M., R.S. Halbrook, and C.A. Arenal. 1999. Predicting starling chick carcass PCB concentrations from PCB concentrations in ingested animal matter. *Archives of Environ. Contamination and Toxicol.* 37:548-553.

Appendix 3, Egg Collection Standard Operating Procedure, notes that, “the data sheet (Appendix B) has adjustments for bald eagles.” The formula for calculating the volume of a bald eagle egg based on length and width measurements was not included on the data sheet. The volume of each egg was determined by water displacement, per Appendix 3.

Footnote 2 on the Avian Egg Data Sheet should refer to the calculated maximum egg volume in the Conversion Factor equation.

Footnote 3 on the Avian Egg Data Sheet should read, “If you have both, use the larger.”

WORK PLAN FOR THE COLLECTION OF EGGS FROM SPOTTED SANDPIPERS, AMERICAN WOODCOCK, BELTED KINGFISHER, AMERICAN ROBIN, RED-WINGED BLACKBIRD, AND EASTERN PHEOBE ASSOCIATED WITH THE HUDSON RIVER FROM HUDSON FALLS TO SCHODACK ISLAND, NEW YORK

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SURVEY TEAM ACKNOWLEDGEMENT OF WORK PLAN REVIEW

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1.0 INTRODUCTION

The General Electric Company (GE) is believed to have discharged between 209,000 and 1.3 million pounds of polychlorinated biphenyls (PCBs) into the Hudson River between the 1940s and 1977 (Baker *et al.* 2001). These PCBs have been detected in the sediment, water, and biota of the Hudson River at levels of potential ecological concern (TAMS Consultants, Inc. and Menzie-Cura & Associates, Inc. 2000). A recent study documented elevated PCB levels in Hudson River floodplain soils (S E A Consultants, Inc. 2001). As a result of this contamination, the Hudson River Natural Resource Trustees (Trustees) are conducting a natural resource damage assessment (NRDA) of the Hudson River. The Trustees include the State of New York acting through the New York State Department of Environmental Conservation (NYSDEC), the Department of the Interior acting through the U.S. Fish and Wildlife Service (USFWS), and the Department of Commerce acting through the National Oceanic and Atmospheric Administration (NOAA).

The Trustees plan to conduct a survey of six avian species, including spotted sandpiper (*Actitis macularia*), American woodcock (*Scolopax minor*), belted kingfisher (*Ceryle alcyon*), American robin (*Turdus migratorius*), red-winged blackbird (*Agelaius phoeniceus*), and Eastern phoebe (*Sayornis phoebe*). The Trustees plan to identify active nests of these species in and near the Hudson River floodplain, and to further determine, through additional analysis, if eggs from each species have elevated levels of PCBs. A limited number of nests from additional species will also be identified on an opportunistic basis. The primary study area includes the Hudson River and its floodplain from Hudson Falls south to Schodack Island.

1.1 Objectives

The objectives of this study are to:

- identify suitable nesting habitat for spotted sandpiper, American woodcock, belted kingfisher, American robin, red-winged blackbird, and Eastern phoebe in the primary study area within four general geographic zones in the study area;

- identify active nests for each species in each of four geographic zones within the study area and collect one egg sample from each nest, up to a maximum of 40 egg samples per species[1]; and

- process egg samples to prepare them for chemical analyses.

1.2 Project Approach

In this section of the work plan we describe the rationale and overview of the approach and methods that will be used to identify potential sampling areas per species, the approach for conducting surveys, and the process of egg collection and analysis.

[1] Depending on egg mass, a single sample may consist of two eggs.

1.2.1 Species Selection and Rationale

1.2.1.1 PCBs in Birds

A number of studies have documented that bird species can absorb PCBs from prey items and feed (Drouillard and Norstrom 2001a, Custer *et al.* 1997 and 1999, Froese *et al*. 1998, Larson *et al*. 1996, and Secord *et al.* 1999). Numerous studies have further shown that a species' position within the food chain affects the amount of PCBs that it will bioaccumulate (Focardi *et al.* 1988, Senthilkhumar *et al.* 2002, Zimmerman *et al.* 1997). In particular, avian species that primarily feed on fish or other birds tend to bioaccumulate PCBs to a greater extent than do species that feed at lower trophic levels (Forcardi *et al.* 1988, Prestt *et al*. 1970, Senthiklumar *et al.* 2002).

Females can pass on PCBs to their eggs, although the degree of such maternal transfers varies considerably amongst species. In general, altricial and semiprecocial species have lower egg to maternal tissue ratios (0.3 to 0.7) than do precocial species (0.6 to as high as 5.0) that invest larger quantities of lipids and energy into egg production (Drouillard and Norstrom 2001b). This suggests that the amount of energy that goes into egg production, clutch size, and frequency of egg laying may be important variables in the ratio of egg to maternal tissue concentrations.

In either adults or eggs, PCBs can reach concentrations that may cause toxic effects (Fernie *et al*. 2001, Hoffman *et al*. 1998, Stratus Consulting, Inc. 1999). Generally speaking, these toxic effects can include mortality, malformations, decreased body weight, and/or reproductive impairment. The nature and severity of the effect depends on the species, dosage, PCB congener(s), and the birds' physiology (Barron *et al.* 1995, Eisler 2000, Eisler and Belisle 1996, Fernie *et al*. 2001, Environment Canada 1998, and Hoffman *et al*. 1996a, 1996b, 1998). Effects of PCBs on adult birds' reproductive behavior include increased amounts of time spent in the courtship phase, reduced pair bond formation, delayed nest building, building nests of poor quality, delayed egg laying, burying eggs in nesting material, decreased nest attentiveness, inconsistent incubation causing fluctuations in egg temperatures, and increased nest abandonment (Arena *et al.* 1999, Fernie *et al.* 2001, McCarty and Secord 1999a and 1999b, Peakell and Peakell 1973, Tori and Peterle 1983).

Mortality, deformity, and other toxicological effects to embryos and nestlings have been found to be correlated with PCB contamination in eggs; again, effects vary greatly according to species sensitivity, levels of contamination, and composition of PCB mixtures (Brunstorm and Reutergardh 1986, Brunstorm 1989, Bush *et al*. 1974, Hill *et al*. 1975). Known effects include decreased hatching success, delayed hatching, increased embryonic deformity rates (i.e., beak and limb deformities, cardiovascular malformation), inhibition of lymphoid development, edema (pericardial and subcutaneous), liver lesions, decreased organ weights, and reduced growth and survival (Barron *et al.* 1995, Bosveld *et al.* 1995, Bosveld and Van den Berg 1994, Fernie *et al.* 2001, Gilbertson *et al.* 1991, Hoffman *et al.* 1986, Hoffman *et al.* 1998, Larson *et al.* 1996, McCarty and Secord 1999a, 1999b, Powell *et al.* 1998, Yamashita *et al.* 1993).

1.2.1.2 Selected Species

The six species proposed for this study together provide a balanced approach in that they use different types of habitats common to the Hudson River area, they consume different types of foods and generally represent different ecological guilds (Appendix 1). The American woodcock and

American robin feed extensively on earthworms (DeGraaf and Yamasaki 2001, Sheldon 1971) both in uplands and wetlands. Robins also have a more omnivorous diet that includes fruits and insects (Ehrlich *et al.* 1988), while woodcock also consume ground-dwelling insects (Ehrlich *et al.* 1988). Spotted sandpipers, Eastern phoebes, and red-winged blackbirds consume extensive amounts of insects, often from wetland or riparian habitats (Degraaf and Yamasaki 2001, Ehrlich *et al.* 1988). Belted kingfishers primarily consume extensive amounts of small fish but also consume aquatic invertebrates (Ehrlich *et al.* 1988).

All six species are suitable to study in that they are reported to be relatively common breeders in the Hudson River floodplain (Andrle and Carroll 1988) and can use wetlands for some portion of their life cycle (DeGraaf and Yamasaki 2000). For example, spotted sandpiper, American woodcock, and belted kingfisher are substantially dependent on floodplain wetlands (DeGraaf and Yamasaki 2000). Red-winged blackbirds use emergent wetlands but may also use upland habitats (DeGraaf and Yamasaki 2000, Ehrlich *et al.* 1988). American robins and Eastern phoebes are habitat generalists that use a variety of communities, including urban settings (DeGraaf and Yamasaki 2000, Ehrlich *et al.* 1988, and Veit and Petersen 1993). Robin nests from the previous breeding season were readily observed in shrubs growing immediately adjacent to the river during February 2002. PCB contamination of Hudson River floodplain soils was recently documented (S E A Consultants, Inc. 2001). Many of the prey species consumed by the six study species include those for which PCB accumulation has been documented in other regions, and PCB accumulation in prey items from the Hudson River is likely to exist.

Relatively few PCB studies have been conducted to date on the six species proposed for this study. The majority of studies involving the target species report levels of PCBs accumulated by individuals, PCB levels in diets, and/or environmental PCB levels (McLane *et al.* 1971, 1976, 1978, 1984; Knupp *et al.* 1976; Walker 1977; NYDEC 1981; Heinz *et al.* 1984; Day *et al.* 1991; Eaton and Carr 1991; Bishop *et al.* 1995; Kannan *et al.* 1998). Additional studies report levels of PCBs in the carcasses of poisoned birds; however, levels were typically below reported lethal levels, and the cause of death was attributed to other organochlorines such as DDE, DDT, dieldrin, chlordane, heptachlor, and mirex (Stone and Okoniewski 1988**,** Okoniewski and Novesky 1993, Stansley and Roscoe 1999). Stickel *et al.* (1984) found that the likelihood of PCB-induced mortality for common grackles (*Quiscalus quiscula*), European starlings (*Sturnus vulgaris*), red-winged blackbirds, and brown-headed cowbirds (*Molothrus ater*) increased substantially above PCB brain levels of 310 ppm.

Few field studies of the effects of PCBs on Hudson River bird populations exist. One recent set of studies examined tree swallows (*Tachycineta bicolor*) in the Hudson River basin. Tree swallows nesting along the upper Hudson River have known PCB concentrations up to 114,000 ng/g for total PCBs based on fresh wet weight of adult whole bodies (Secord *et al.* 1999, Stapleton *et al.* 2001). Tree swallows from the Hudson River were documented to have egg PCB concentrations ranging from 9,320 to 29,500 ng/g, while concentrations in nestlings ranged from 3,710 to 62,200 ng/g (McCarty and Secord 1999a). Reproductive effects observed included supernormal clutch size, reduced hatchability due to failure of embryos to develop (presumably infertile) and death of deformed embryos, high rates of nest abandonment, and other abnormal parental behavior (McCarty and Secord 1999a, 1999b). Tree swallows have been able to successfully reproduce with PCB concentrations that cause 100% embryo mortality in more sensitive species (McCarty and Secord 1999a). McCarty and Secord (1999b) also described abnormal nesting behavior of tree swallows and inferred that chemical contamination can possibly interfere with behavior.

Few data currently exist to generate definitive conclusions regarding PCB exposure and effects on other wildlife species that inhabit the Hudson River floodplain. A recent study, however, indicates that some small mammals collected from floodplain areas have elevated levels of PCBs in their tissues (S E A Consultants, Inc. 2001). Avian species that inhabit the floodplain or that forage on a prey base with an ecological connection to the floodplain may also be exposed to PCBs. Even if nesting occurs outside the floodplain, some avian species may still have the potential to consume prey that may be contaminated by Hudson River PCBs. This study will provide the Trustees with information regarding PCB exposure in the eggs of six common avian species that nest in or near floodplain areas. These data may assist the Trustees in the development of possible future natural resource damage assessment studies.

1.2.2 Survey Overview

The primary objective of this study is to collect the egg samples of the six species and to process those samples in anticipation that they will be analyzed to determine if they have elevated levels of PCBs. Ultimately, these data could provide information on how PCBs transfer through the food chain. Surveying for and locating nests of the six species will provide general information on the location, abundance, and habitat use of each within the Hudson River floodplain. Locating nests will require a stepwise approach that considers the specific egg-laying and incubation periods of each species.

General reconnaissance surveys will precede the main study effort to identify potential habitats of the study species and various logistical components related to completing the surveys. Literature reviews and contacts with local birders or birder groups will help with identifying suitable habitats and with identifying private landowners that may need to be contacted. Habitat maps will be prepared on aerial photos using the reconnaissance information, which will serve as the base map for the surveys. Avian surveys will be conducted in pre-identified habitat to locate breeding individuals of the study species. These surveys will lead to the nest search effort, which will be based on the locations of the breeding birds, and will result in a detailed search effort. One egg sample from each target nest found will be collected and processed. Some samples, especially for small eggs, may require collecting two eggs.

2.0 METHODS

In this section of the work plan we describe the methods that will be used to identify potential breeding habitat, contact landowners for permission to access property, complete the breeding bird surveys, collect eggs to be submitted for chemical analysis, and generate and report the results.

2.1 Literature Search

Before field surveys are performed, scientific and technical literature will be reviewed to determine the distribution of the six study species in the Hudson River drainage system. As part of this effort, local and regional experts will be consulted to obtain unpublished records regarding the occurrences of these species in the area. For example, it is likely that some regional experts may have knowledge of belted kingfisher nest locations or American woodcock display areas. This effort will include attempting to contact individuals who performed breeding bird surveys along the Hudson

River, regional biologists, and private groups and/or individuals. The New York Natural Heritage Program, NYSDEC, and the USFWS will also be consulted to determine if records of any of the six study species from the Hudson River drainage are available from surveys sponsored or conducted by these agencies. The U.S. Geological Survey (USGS) (2002) maintains a database of studies on many wildlife species. Natural history and scientific information on these species, including habitat use, diet, home range, reproductive behavior, and effects of contaminants, will be obtained and summarized.

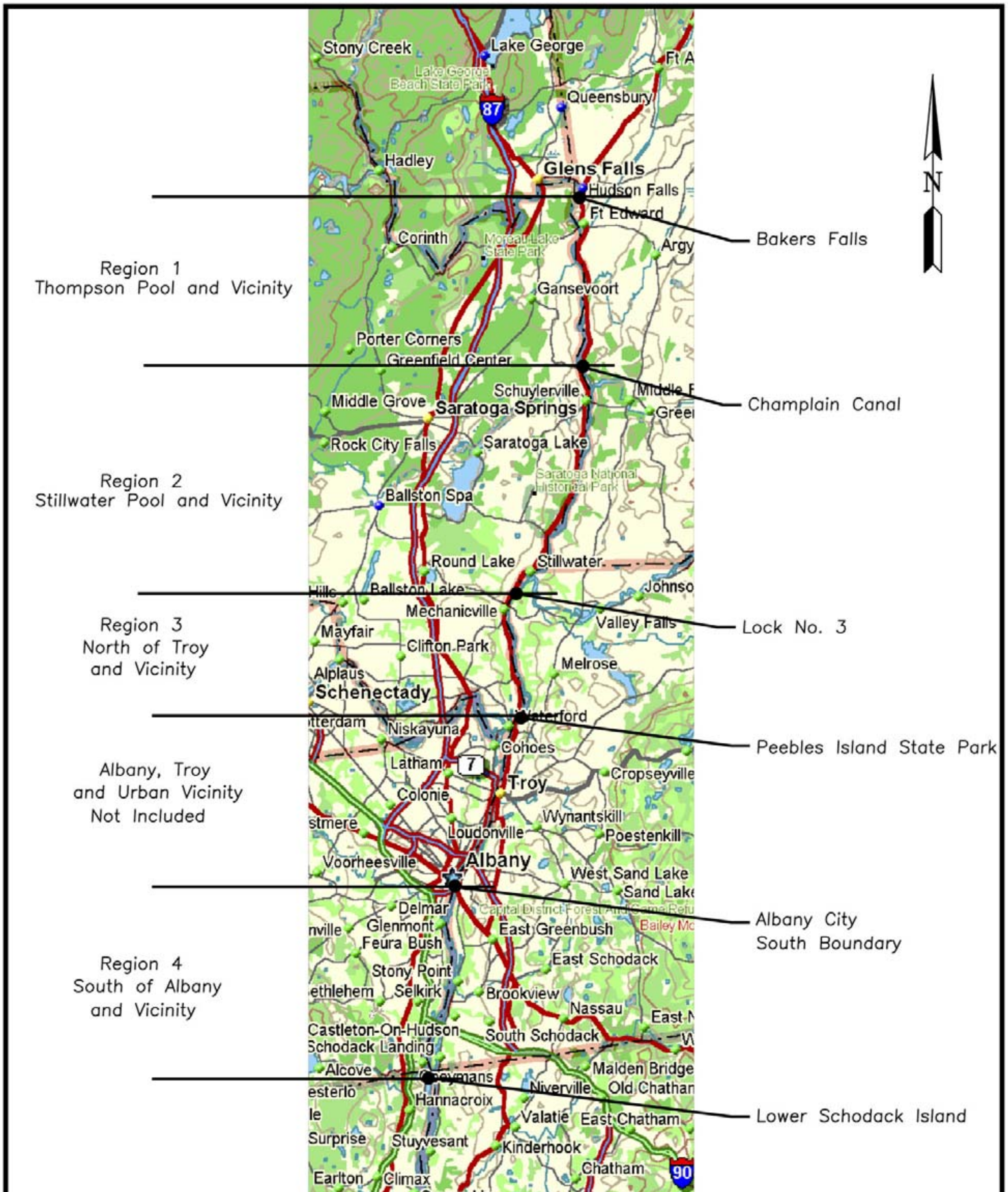
2.2 Habitat Identification

Prior to conducting field surveys, the location, type, and condition of plant communities in the study area will be reviewed through photo-interpretation. Using the descriptive nesting habitat data from the literature (Appendix 1) and past experience, potential survey areas that appear to be suitable breeding habitat will be identified on digital and hard copies of georeferenced aerial photos. Land ownership patterns and access points will also be identified. Following this effort, an on-site, reconnaissance-level habitat survey will be completed to ground-truth aerial photo- interpretation, locate potential nesting habitat for the six study species, and identify public and private lands for surveys.

Vegetative communities will be categorized relative to their potential to provide nesting habitat for each species. For example, sandy banks and bluffs near water resources will be identified as potential nesting sites for belted kingfishers. Old fields, young aspen (*Populus* spp.) stands, and wet thickets that may serve as display grounds and nesting habitat for woodcock will be mapped. Open habitat along water resources (i.e., the river, large streams, shallow emergent wetlands, and ponds and lakes) with potential nesting habitat for spotted sandpipers will be mapped. Emergent marsh habitat can be located on aerial photos and National Wetland Inventory maps. These areas serve as nesting habitat for red-winged blackbirds. Upland and wetland forested habitat will be mapped, especially those areas interspersed with small openings with potential for nesting American robins and Eastern phoebes.

Egg samples will be collected in each of four geographic zones within the study area to provide a balanced sample amongst various portions of the river. The four regions can be approximately described as follows: the six-mile portion of the river known as Thompson Island Pool; Stillwater pool; the area below Stillwater pool extending south to the Troy dam, and the area below the Troy dam extending south to Schodack Island, excluding Albany. Figure 1 provides a reference map of the proposed study area.

Boundaries of public lands will be overlaid onto the vegetation maps to identify study areas with potential easy access. Habitat containing known levels of PCB contamination will also be mapped as a data layer. This information will be used to identify sites with a greater potential for transmittal of PCBs from sediment to the study species. The results of the photo-interpretation and reconnaissance-level survey effort will be a set of vegetation community maps with potentially suitable habitat mapped for each species or their food. Windshield surveys of private land for which access has not been obtained will be completed to locate high potential breeding habitats. These areas will then be surveyed for the study species as appropriate, once permission to access has been obtained.



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2.3 Landowner Contacts

Maps showing the location of areas to survey for the six study species will be compared to land ownership maps obtained from the New York State GIS Cooperative (NYSGIS) and local assessors' offices. The NYSGIS has ArcInfo GIS files showing the location and ownership of public land in the study area. Accessible public lands with suitable habitat will be given priority for study locations, although we expect that privately held lands also would be surveyed. Owners of private land will be identified through the assessors' offices in town and city halls, where their names and addresses will be obtained. We will work with the Trustees to coordinate actual contacts with landowners. A priority approach will be taken as we anticipate that large landowners with the best potential habitat will be contacted first, followed by smaller landowners with poorer quality habitat. Methods of contact will likely include a combination of phone calls, letters, and personal contact.

2.4 Breeding Bird Surveys and Locating Nests

2.4.1 Overview

Breeding bird surveys will be performed to locate potential nest sites of the six study species: spotted sandpiper; American woodcock; belted kingfisher; American robin; Eastern phoebe; and red-winged blackbird. Standard breeding bird survey techniques and methods will generally be followed to prepare survey transects, locate survey stations, and locate breeding territories. These techniques include silent listening and observing within suitable habitat along the river and adjacent roads. The locations of stations will be determined by the suitability of habitat, observations of the study species, and obtaining landowners' permission. The habitat maps and aerial photos will be used to guide members of the survey tem to suitable areas. The techniques will vary by species and their requisite habitat as outlined below. Survey route sites will not be randomly located, since the objective is to locate as many active nests of the study species as possible.

Breeding individuals of the six study species will be identified by sound and sight whenever possible. Observers performing surveys will be trained in identifying calls of the study species by listening to previously made recordings. Similarly, observers will be trained to identify each species through the use of field guides, slides, and videos. Sight identification will be aided by the use of *A Field Guide to the Birds of Eastern and Central North America* (Peterson and Peterson 1980) and by the use of *Field Guide to the Birds of North America* (National Geographic Society 1983). Sound identification will be aided by use of the Cornell Lab of Ornithology *A Field Guide to Bird Songs* (1990) and *Guide to Birds of North America*, Version 3 (2001). Nests, eggs and nestlings identification will be aided by the use of *A Guide to the Nests, Eggs, and Nestlings of North American Birds* (Baicich and Harrison 1997).

2.4.2 Spotted Sandpiper

Spotted sandpipers will be located by surveying the shore of the Hudson River, emergent wetlands, streams, and any other water resources in the area. Visual observations and listening for their alarm call will be used to locate potential breeders. Observing these individuals should help locate nests although extended observations often will be needed to follow the birds to potential nest sites. Spotted sandpipers are polygamous with the female laying up to five clutches and the males tending the nest (Ehrlich *et al.* 1988). The plumage and size of the males and females is identical, as with most shorebirds, therefore, making nest location more difficult. Visual observations of a female early in the egg laying process may lead to more than one nest. Areas with more than one spotted sandpiper will be considered potential nest sites. Observers will monitor these locations from a boat, canoe, or land to locate the nest site, which is usually next to and concealed by a dense tuft of grasses or sedges.

2.4.3 American Woodcock

American woodcock singing ground survey data will be obtained from the USFWS for the study areas. Potential nesting habitat, levels of known contamination, and suspected levels of contamination (based on geomorphology, frequency of flooding, proximity to sources, etc.) will be compared on aerials photos and maps of the potential survey sites. Areas without singing ground survey data but with apparently suitable habitat will also be identified on photos and maps. These data will then be compared to develop a list of prioritized sites for woodcock surveys. Areas with the best habitat, known past occurrence of singing males, and known levels of PCB contamination in floodplain soils will be given priority for survey. The prioritized list of survey sites will be compared to lands for which access has been obtained, and sites will be selected for field surveys. The initial surveys will be conducted from public roads.

Field surveys will progress in two steps: singing ground surveys, followed by nest searches. Because the singing ground surveys will be conducted from public roads, it is not essential that permission be obtained prior to listening for singing males. Singing ground surveys will generally follow USFWS North American Woodcock Singing Ground Survey protocol (USFWS 1995). Surveys are expected to begin around April 1, but can start sooner if spring is early. Surveys are expected to continue until about May 10. The timing of surveys is critical because singing males usually display for a short period (usually 30 to 40 minutes) each night. Surveyors will be prepared to begin each survey slightly before sunset. If the sky is clear or up to and including ¾ overcast, 22 minutes will be added to the sunset time to determine the starting time, and 15 minutes will be added if the sky is more than ¾ overcast (USFWS 1995).

At each potential singing male survey site, surveyors will stop and shut off the car, get out and silently listen for 2 minutes. The location of each male heard singing (i.e., peenting) or flying will be estimated using a hand compass, aerial photos, and maps of the study area. If the location cannot be accurately located, the observer will drive closer and attempt to locate the singing male. Once located, the observer will continue to the next location of suitable habitat and repeat the survey procedure until dark. One singing ground survey (approximately 10 sites spaced 1/8-mile apart) can be completed per evening per observer.

Woodcock nest searches will focus on wooded habitat within 300 to 400 feet of where singing males were observed, as females often select nest sites within 300 feet of the males' territory (Sheldon 1971). Several field staff, possibly accompanied by a bird dog, will perform nest searches. A systematic search of potential nest sites will occur by walking back and forth through each area until a bird is flushed, or until the site has been thoroughly searched and no birds observed. When a bird flushes, the location will be noted and a very slow search of the flush site will be made. Incubating female woodcock will only flush when there is eminent danger of trampling, so when a female does flush, chances are that the nest is very close. Once a nest is found, one egg will be collected using the methods described in Section 2.6. The location of each nest will be located using GPS equipment.

2.4.4 Belted Kingfisher

The habitat survey effort will locate potentially suitable habitat along the river, along large streams, and along lakes and ponds. Contacts made with local and regional biologists and local birders will be used to help pinpoint known or potential nesting sites. These identified areas can be compared to known areas of elevated PCB concentrations along the river and in floodplain areas to identify preferred sampling areas.

Belted kingfisher nests are burrows within banks and are generally in open situations that are fairly accessible. Males and females tend the nest; therefore, locating perched kingfishers and observing their movements helps locate active nest sites. Potential habitat will be visually scanned from a boat and/or canoe or from land immediately along the river. Kingfishers will be observed to assess activity to and from a nest and hence locate the nest. Conversely, burrows can be visually located and then observed for kingfisher activity. Using either procedure will require dedicated and patient observation, often watching and waiting to observe kingfisher activity.

Active nest sites will be carefully approached, since the burrows are often on sandy bluffs that may have limited and difficult access. The bluffs may not be stable, and excessive activity could create erosion and damage the burrow. The survey team will develop a general plan of action before approaching the nest. Approaching a nest could require the use of a rope ladder, extension ladder, or rope harness. The burrow will be visually inspected (a flashlight and compact mirror may be used) first, and then a burrow scope will be used to determine the activity status of the nest, the presence or number of eggs, and the length of the burrow. Kingfisher burrows are normally 3 – 6 feet long but can be up to 15 feet in length. If the eggs can be readily observed from the burrow entrance, one egg will be retrieved manually using a telescoping pole with a small padded or blunt "J" shaped hook or "pincher" on the end. If the burrow is deep and the eggs cannot be visually located, then the burrow scope will remain in place and the telescoping pole used to retrieve one egg. The survey team will need to monitor the nest with the scope and a head mounted display system to guide the telescoping pole into the burrow. Once a nest is found, one egg will be collected using the methods described in Section 2.6. In situations where it is unsafe to approach a burrow or for burrows that are too deep or otherwise unsuitable for retrieving an egg, the survey team will not attempt to retrieve an egg.

2.4.5 American Robins, Eastern Phoebes, and Red-Winged Blackbirds

American robins, Eastern phoebes, and red-winged blackbirds can be located using the typical breeding bird survey techniques. Eastern phoebes and American robins are habitat generalists and locating the birds should be possible through habitat mapping and visual surveys. Red-winged blackbird nesting habitat should be identified as emergent wetlands with vegetative structure to support the nest. Potential nesting habitat, levels of known contamination, and suspected levels of contamination will be compared on aerials photos and maps of the potential survey sites as with the other species. Suitable habitat immediately adjacent to the river, especially near areas of known or suspected contamination, will be given the first priority for nesting surveys. Roadside ditches, man-made and natural ponds, and agricultural habitat adjacent to the river will serve as the focal habitat for the red-winged blackbird. Priority habitats will be located on the aerial photos based on the above criteria. Locating nests of these three species will require close visual observation either from a distance or walking and searching selected areas.

Early morning roadside surveys will be completed for each species to locate singing or calling birds. Surveys will begin approximately one-half hour before sunrise and continue until late morning when most singing and display activity has ended. Biologists may extend surveys into the afternoon for red-winged blackbirds, as their territorial activity and communal nature may support an extended survey time.

Robins have a very distinct territorial song, often sung by the male in an area near the nest. Locating a singing male, along with knowledge of the typical robin nest locations, will help focus the nest search effort (Appendix 1). Once a singing robin is located, quiet observation is needed to observe nesting activity and locate an active nest. Upon locating a nest, a telescoping “tree peeper” will be used to look into the nest and determine the presence of eggs. Care will be taken to remove one egg from each nest and to minimize disturbance to the incubating robin.

Eastern phoebes are often observed perched on small trees and shrubs, utility lines, and fences posts in open woodland, agricultural, and wetland habitats. Their habit of spreading and pumping their tail lends them visibility. Often phoebes nest in or on a variety of human built structures including farm buildings and under bridges (Ehrlich *et al.* 1988). The nest is comprised of a mud base with other natural materials. Observers will look for these clues to focus in on a nesting site. Locating this visible species and observing foraging trips should lead the survey team into the proximity of the nest and, in fact, may lead to locating a nest. Nests can also be located by scanning suitable nesting structures and carefully watching for phoebes and following them to the nest. Each nest should be investigated visually, using a “tree peeper” as needed. Initially, one egg can be removed from each nest; if the egg mass does not meet the minimum mass requirement, a second egg will be collected. For some species (e.g., phoebes and swallows) we anticipate that two eggs will need to be routinely collected.

Red-winged blackbird territories can be located based on observing displaying males generally within emergent wetland habitat. It is not unusual for good habitat to contain numerous nesting red-winged blackbirds, increasing the potential for locating multiple nests in close proximity (Case and Hewitt 1963). Scanning emergent habitat around displaying males should bring the survey team to a close nest location. Watching for female red-winged blackbirds will generally lead to a nest. Often, walking through the habitat will cause the female to flush and make locating the nest possible.

2.4.6 Opportunistic Collection

The location and collection of eggs for the six study species may provide opportunities for collection of eggs from other species, especially for species with common habitats. The collection of egg samples for 11 additional species will be based solely on the opportunities for survey team members to locate the nests of these species. The 11 species identified for opportunistic egg sample collection are green heron (*Butorides virescens*), great blue heron (*Ardea herodias*), Eastern screech owl (*Otus asio*), American kestrel (*Falco sparverius*), common grackle, hooded merganser (*Lophodytes cucullatus*), cliff swallow (*Hirundo pyrrhonota*), northern rough-winged swallow (*Stelgidopteryx serripennis*), bank swallow (*Riparia riparia*), barn swallow (*Hirundo rustica*), and Eastern bluebird (*Sialia sialis*). Some of these species are somewhat less associated with the riverine habitat or are thought to be more difficult to study. For example, green heron nests are relatively difficult to locate and great blue heron rookeries are documented in the study region, but are not common. Both species have the potential to be affected by PCB contamination from the fish and other aquatic species that they consume. American kestrel and Eastern bluebird egg samples can be obtained from nests in natural sites and artificial structures. These species have a less direct ecological connection to the river as they are largely found in (and tend to forage in) upland habitats. Common grackles are connected to the river and are found in many wetland and upland habitats. They have a loose colonial nesting practice, which may make obtaining egg samples relatively easy.

Biologists collecting egg samples for the six study species will observe and attempt to locate nests of these 11 additional species. The same natural history information on habitat use, nest site characteristics, egg size, and egg description will be used to help locate nests of these species. The same egg sampling procedures will be used for obtaining and processing samples.

2.4.7 Data Location and Management

The location of transects, survey stations, all study species observations, and locations of nests will be plotted on maps or georeferenced aerial photos of the study area. Each nest will be uniquely numbered and designated by species, habitat community, vegetation located in (where applicable), and coalesced with the egg collection data (as discussed below). GPS data will be collected for each located nest and as needed for transects; however, because of the quality of digital georeferenced aerial photos available (i.e., you can locate individual trees, houses, and other landmarks) it is unlikely that transects will need to be surveyed. Notes on the approximate numbers of each species observed per area will be recorded.

2.5 Study Species Egg Collection and Analysis

One egg sample (containing up to two eggs) will be collected from each nest of the six study species. Before collection begins, permits from the NYSDEC, NPS, and USFWS will be obtained to collect eggs. The USFWS will assist in the effort to obtain permits. At each nest site suspected of having an active nest, a survey team will use a peeper probe or mirror and extension pole to peer inside the nest to determine if an adult is still on the nest, or if any of the eggs have hatched. These observations will be recorded in field notebooks. After determining that eggs are available for collection, a survey team member will reach into the nest and collect an egg. Scientists will wear nitrile gloves to reduce exposure to any parasites and diseases that may be present in the nest or on an egg. When eggs are removed, the total clutch size before egg removal will be recorded. Each egg will be photographed and the film roll and photo log number will be recorded in the field notebook. This information will be logged with the georeferenced area and other identification information. Each egg from the smaller species will be weighed using a field balance to determine if the minimum egg mass is achieved. If the minimum mass is not achieved with one egg then a second egg from that clutch will be collected. The collected egg(s) will be marked with the sample collection nest identification (ID) number using a graphite pencil and wrapped in a protective manner with aluminum foil that is also labeled with the nest number, so that it does not break until it is placed in an egg container.

Wrapped eggs that have been securely placed in an egg container will be put into a cooler or secure box and transported to a NYSDEC lab for processing. Eggs will ideally be processed the same day they are collected and in any event will be processed within 48 hours of collection. A list of lab facilities available for processing eggs is in Appendix 2. Once in the lab, each egg will be measured, processed and stored according to the Standard Operating Procedure for Egg Harvest (Appendix 3) with the appropriate Chain of Custody (COC) (see Section 3.2.3 and Appendix 4). Egg contents will be sent to NOAA's archive freezer (Sand Point Archive, Seattle, Washington) or to the DEC Hale Creek lab for storage at a temperature of minus 20 degrees Celsius until they can be shipped to the program analytical laboratory for chemical analysis. Conducting the chemical analyses is not part of this work plan.

2.6 Contingencies

When conducting bird studies, disturbance can create biases that affect the gathering and analysis of data and can have effects on the birds being studied themselves (Gaunt *et al.* 1997). As Gaunt *et al.* (1997) point out, in field ornithology, adverse affects are most commonly associated with nest visits, which can result in biased data and decreased reproductive success. Investigators can cause nest desertion, damage to eggs and young from frightened adults, thermo-damage to eggs or young, mortality from missed feedings or predation, or accidental death from mishandling (Fyfe and Olendorff 1976).

During the surveys, all efforts will be made to minimize disturbance to the nesting study species. These efforts will include minimizing the number of surveys and nest visits and the type of nest visits, particularly during the early parts of incubation (Grier and Fyfe 1987). To the extent possible remote observation of nests will be performed using binoculars or spotting scopes. If sufficient data cannot be obtained remotely, then inspection from a short distance (i.e., walking up to the nesting tree) or direct inspection (i.e., actually climbing a tree) will occur; however, these activities will only occur if they are not believed to be detrimental to the nesting birds. Many raptor species are believed to be most sensitive to disturbance just prior to egg laying up to the onset of incubation, from first hatching until the young become endothermic, and just prior to fledging (Steenhof 1987). Nest visits during these periods will be avoided as much as practicable, but cannot be completely avoided. Additionally, nest visits will not be performed when weather conditions could prove detrimental to eggs or young (e.g., during a cold, rainy day, or during the middle of a hot, sunny day). Nest visits will be also kept as short as possible.

2.7 Data Analysis

Data endpoints for the egg collection study will include egg mass and volume, egg length and breadth, egg shell thickness, weight of the contents (fresh weight will be back calculated using methods described in Appendix 3), fertility (i.e., fertilized or not), embryo position, embryo deformities, and contamination level. Comparisons of data endpoints will be completed between the four geographic areas. Two-group comparisons of data endpoints will be made using Student's t-test (parametric) or the Mann-Whitney U test (nonparametric). Multiple group comparisons will rely on ANOVA (parametric) or Kruskal-Wallis (nonparametric) tests. All analyses will be performed using the Statistica® (StatSoft 1999) software package.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Data Quality Objectives, Indicators, and Assessment

3.1.1 Overview

This study is being conducted in accordance with the Quality Assurance Management Plan for the Trustees' Hudson River NRDA. As described in the plan, four general elements of quality assurance/quality control (QA/QC) must be addressed for each data collection effort:

- project management
- data generation and acquisition
- assessment and oversight
- data validation and usability

This section describes the Quality Assurance Plan (QAP) for the breeding bird egg exposure study, based on these four general elements. The objectives of the study are outlined in Section 1.1. To achieve these objectives, the following types of data will be required:

- Breeding bird surveys, nest identification, and egg collection: Accurate species identification is required to locate targeted species in the study area. Egg collection and processing will require following set procedures to insure proper handling and minimizing impacts to nesting individuals.

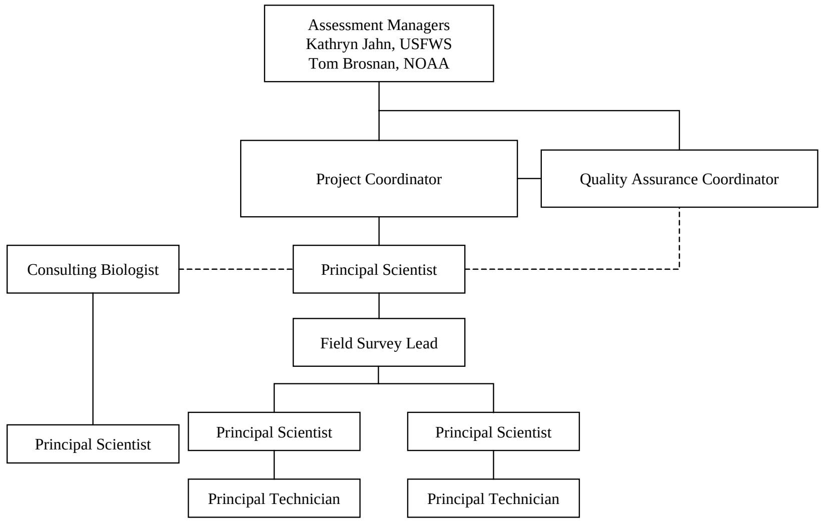
- Egg contamination levels: The laboratory chosen for tissue analysis will follow the requirements of the Hudson River NRDA Analytical QA Plan (in preparation). This effort is not part of the current work plan and will be funded separately.

3.1.2 Project Management

The study team is organized based on tasks and levels of responsibility to ensure good communication between all personnel (Figure 2). The Assessment Managers (Kathryn Jahn, USFWS, and Tom Brosnan, NOAA) have overall project oversight responsibility and provide direction to the Quality Assurance Coordinator. The Assessment Managers also provide direction to the Principal Scientist via the Project Coordinators. The Project Coordinators are responsible for ensuring that adequate coordination and communication occurs amongst the Assessment Managers, Quality Assurance Coordinator, Principal Scientist, and Consulting Biologist. With input from the Consulting Biologist, the Project Scientist is responsible for the project's design and implementation and provides guidance and technical expertise as needed to the Field Survey Lead.

The Field Survey Lead provides instructions to survey teams on all aspects of the project, including quality assurance management. Field survey teams consist of a Project Scientist and a Project Technician, as needed. The Field Survey Lead is responsible for resolving any issues raised by Project Scientists or Technicians. The Field Survey Lead reports to the Principal Scientist, who will work with the Project Coordinators and Quality Assurance Coordinator to ensure that the study is consistent with the overall QA objectives of the NRDA.

Figure 2: Project Management Structure



This work plan for this study was developed to provide detailed and explicit instructions for the field crews to follow in collecting the study data. The plan has been reviewed, commented on, and approved by key parties to the study before the beginning of sample collection. Reliance on a detailed, explicit, and fully reviewed work plan ensures that:

- Study objectives, methods, procedures, and details are completely thought out before sampling.

- Data will be collected in a systematic and consistent way throughout the study.

- Every member of the study team adheres to the requirements of the plan. Each field team member is required to sign a statement that they have read the plan and understand it. In particular, the field crew leaders must make sure that their crews adhere to the plan.

The procedures specified in this plan must be considered somewhat flexible by the field study team. Many events can arise during field data collection that require changes to the procedures being used. In these circumstances, deviations from the plan will be conducted only after consultation between the Project Scientists and Field Survey Lead. Deviations from the work plan will be carefully documented, as will a detailed explanation as to why the deviations were necessary.

3.2 Data Generation and Acquisition

3.2.1 Data Quality Objectives

Data developed in this study must meet standards of precision, accuracy, completeness, representativeness, comparability, and sensitivity, and be consistent with sound scientific methodology appropriate to the data quality objectives.

Precision is defined as the level of agreement of repeated independent measurements of the same characteristic. For this study, repeated independent measurements of species identification (e.g., distinguishing between a similar species) will not be possible for specimens that are not collected, or for calls that are not recorded. However, agreement between surveyors regarding species identification must be obtained for verification. This will occur in the field on a daily basis as surveys are conducted. Precision may also be evaluated by assessing the degree to which surveys are consistent among sites. The frequency and type of field checks are listed in Table 1.

Accuracy is defined as the agreement of a measurement with its true value. For the parameters unique to the field portion of this study, accuracy means that the target animals are correctly identified and counted. Project Scientists and Technicians will be required to pass a test identifying each target species visually (adults, eggs, and nests) and by call before they can perform field surveys. The Field Survey Lead will conduct this test. Accuracy for analytical data collected as part of egg analysis will be defined in the Hudson River NRDA Analytical QA/QC Plan (in preparation).

Completeness is defined as the percentage of the planned samples actually collected and processed. Although sample sizes cannot be predetermined, observations must be conducted throughout the season when the breeding birds are present in the study area and in each habitat that these species could use where access is granted. The full distribution of study efforts within those parameters is a measure of the completeness of this study.

Representativeness is defined as the degree to which the data accurately reflect the characteristics present at the sampling location at the time of sampling. Obtaining representative data for this study will be ensured through the establishment of a thorough literature review to identify life history characteristics, breeding habitat, and nest site descriptions, and by completing field investigations in a manner to determine if those species are present. The study design employs standardized breeding bird survey techniques that have been proven acceptable for breeding bird surveys in different parts of North America.

Comparability is defined as the measure of confidence with which results from this study may be compared to another similar data set. Because of the nature of the study, there cannot be a duplication of effort in the same area at the same time. Comparability will be attained through use of standardized, peer-reviewed bird survey techniques that are commonly used in bird surveys in different parts of North America.

Sensitivity is defined as the ability of a measurement technique or instrument to operate at a level sufficient to measure the parameter of interest. For data specific to this study, sensitivity will pertain to the ability to locate and identify the six study species and their nests. This process is a stepwise approach that requires ornithological expertise. First, potentially suitable habitat must be located through the use of aerial photographs, general habitat reconnaissance, and specific habitat assessment. Once suitable breeding habitat is located, breeding bird surveys can begin. Surveys involve using visual searches and silent listening to locate the species for which there is potentially suitable habitat. In many cases, a bird will be identified through silent listening by a territorial, breeding, or alarm call or song. Furthermore, the surveyor must be able to follow the individual bird and locate the nest site and nest. Therefore, species identification includes knowledge of songs and calls, visual identification, territorial behavior, habitat use, nest site selection, and nest and egg identification.

Table 1. QAP Type of Field Checks and Frequency.

Type of Field Activity	Measurement	Minimum Frequency of Check by Field Survey Lead or Principal Scientist	Acceptance Criteria
Study species identification by sight	Each study species can be identified by sight and using a field guide for confirmation.	Once before beginning of study, and then monthly. Regular discussions between staff are expected. Photographs, slides, and video images of the six study species will be used to check identification.	One hundred percent accuracy on identification.
Study species identification by sound	Each study species can be identified by sound.	Once before beginning of study, and then monthly. Regular discussions between staff are expected. Sound recordings will be used to check identification.	One hundred percent accuracy on identification.
Study species nest and egg identification	Each study species nests and eggs can be identified by sight and using a field guide for confirmation.	Once before beginning of study, and then monthly. Regular discussions between staff are expected. Each study species using photographs, slides, and video images.	One hundred percent accuracy on identification.
Orienteering, aerial photo interpretation, and location plotting	Field personnel can locate positions on an aerial photo of the study area.	Once before beginning of study. Staff will have regular discussions in regard to where work is being completed and where nests are found.	Personnel can locate positions of specific features on aerial photos correctly.
GPS data collection and data downloading	Field personnel can operate GPS equipment and transfer data to computers.	Once before beginning of study, and then as data is downloaded and verified.	Control point data collected in the field matches up to correct locations on georeferenced aerial photos of the study area.
Completion of data forms	Data forms are filled out each day correctly and completely.	Weekly.	Data forms are complete, legible, and accurate.
Egg collection	Eggs are properly labeled when collected and then transferred to lab for analysis.	Each day an egg is collected.	Each egg is correctly assigned a sample ID number.
Egg analysis	Eggs contents are processed according to the SOP.	Each day egg contents are processed or every 20 samples.	Egg content samples are prepared for shipment to NOAA's or DEC's archive freezer per the SOP.

3.2.2 Study Documentation

All study activities will be documented in waterproof field notebooks and data forms, which will be placed into 3-ring binders. To the extent possible, information will be recorded on pre-formatted data sheets. The use of pre-formatted data sheets is a QA/QC measure designed to:

- ensure that all necessary and relevant information is recorded for each sample and each sampling activity,
- serve as a checklist for the field crews to help ensure completeness of the data collection effort,
- assist the field crews by making data recording more efficient, and
- minimize the problem of illegible field notebook entries.

Each field crew will have a single field data recorder responsible for recording information in field notebooks or on data forms. Assigning this responsibility to a single person will help ensure that documentation is complete and consistent throughout the sampling event. The field data recorder is also responsible for the care, custody, and disposition of the field notebook.

Field notebook entries will be made in waterproof ink, and corrections will be made with a single line through the error accompanied by the correction date and corrector's initials. Each completed data sheet will be reviewed, corrected (if necessary), and initialed by the field data recorder and the appropriate field crew leader. Following completion of the study, field notebook originals will be retained as specified in Section 3.4.

3.2.3 Chain of Custody Procedures

Strict COC procedures will be used throughout the study. The COC procedure will begin when an egg is collected from the nest. A COC form is shown in Appendix 4. These forms will be used to maintain records of sample collection, sample transfer between personnel, sample shipment, and sample receipt by NOAA or DEC for storage in a freezer, or receipt by the analytical lab. Each sample collected will be listed on the COC forms. A separate form will be used for each cooler that is shipped. The original COC will accompany the samples. The field personnel will maintain a copy of the COC. The signatures of the persons shipping and receiving the samples, and the date and time of transfer, will be documented on the COC forms. An air-bill can be used to document the transfer of a sample from the field team to the shipper, and from the shipper to the freezer archive or the analytical lab.

All sections of the COC form will be completed with information pertaining to the sample collection. All samples included in the sample catalog will be clearly listed. The time, date, location, identifier (i.e., sample ID number), type of sample, and number and size of containers will also be listed on the form. If more than one cooler is required to ship the samples, a separate form will be used listing the samples actually held in each cooler. An indication of the number of coolers per shipment (e.g., 1 of 3) will be listed on the form. Once the form is completely filled out, it will be placed in a clear plastic shipping window and securely attached to the inside of the cooler. Each cooler will be sturdy, well sealed with filament tape, and have an unbroken signed custody seal. All materials, samples, and coolers will be kept in locked locations all the time until shipped.

All samples collected will be uniquely identified with a label attached directly to the container. Label information will be recorded using a waterproof marker and will include the sample ID number, species, type of sample (egg), time and date of collection, project name, sample location, and sampler's initials. Much of this information will be pre-filled before sampling.

The following sample identification code will be used "SP-NES-NUM."

"SP" will be a 2-letter code that designates the species and sample type for the six study species:

- SS = spotted sandpiper egg
- AW = American woodcock egg
- BK = belted kingfisher egg
- AR = American robin egg
- RB= red-winged blackbird egg
- EP = Eastern phoebe egg

A likewise designation is provided for each of the "opportunistic" species:

- GH = green heron egg
- BH = great blue heron egg
- AK = American kestrel egg
- SO = Eastern screech owl egg
- EB = Eastern bluebird egg
- CG = common grackle egg
- HM = hooded merganser egg
- NS = barn swallow egg
- RS = rough-winged swallow egg
- BS = bank swallow egg
- CS = cliff swallow egg

"NUM" will be a unique three-digit numerical code that corresponds to the egg sample (numbers 001 – 499). "NES" will be a unique three-digit numerical code that corresponds to the nest number for samples (numbers 001 – 499) associated with an active nest. Each field crew team will have designated number ranges that they can work from to avoid duplication of the numbering sequence.

When egg samples are first removed from the nest, they will be marked with the sample type code (e.g., SS, AW, BK), egg sample number, and nest number on the outside of the egg using a pencil. They will then be wrapped in aluminum foil, which will also be labeled with the nest number, using a permanent marker. Eggs will be transported to the processing facility in egg containers or a similar box that protects from breakage. Once in the processing facility, the labels on the foil and on the egg will be double checked against the data forms and field survey notebooks to verify the identification code.

3.2.4 Personnel Experience and Training

Field sampling crews will receive explicit instructions in the execution of this work plan. The field crews will be instructed in the field before beginning any sampling, and the instructions will be repeated or refreshed during the sampling period as necessary (Table 1). A senior field scientist with experience in breeding bird survey techniques will direct all fieldwork. Field crew members will be trained to identify each study species by sight and sound, their habitat, nests, and eggs. Prior to conducting actual surveys, field crews will be required to study and listen to previously recorded birdcalls, and to pass an identification test.

3.3 Assessment and Oversight

The QA management plan specifies that studies that generate data will be audited to ensure that the project-specific plans are being properly implemented. Several mechanisms for internal audits of the data generation process will be used for the breeding bird egg exposure study. These mechanisms include:

- A project management structure that defines clear lines of responsibility and ensures communication between field crews and with the Field Survey Lead. Clear responsibilities and communication can serve as a means of providing internal audits of the sample collection process as it proceeds.

- A requirement that field notebooks and data forms be completed daily and be reviewed weekly by the Field Survey Lead or Principal Scientist.

- The use of pre-formatted data sheets that serve as a checklist for sampling procedures, thereby helping to ensure that sampling is complete.

- The sampling will not begin until approval is received from the Quality Assurance Coordinator or their delegate. The Quality Assurance Coordinator or designee will conduct a field audit of procedures and documentation of the study.

3.4 Data Validation and Usability

This study employs standard, repeatable methodology available in the scientific literature for collecting breeding bird occurrence data. The work plan for this survey has been extensively reviewed for the adequacy of the sampling design and methods. The original field notebooks will be maintained and archived for a minimum of eight years. Disposal of the notebooks will take place after this timeframe unless a longer archive period is requested. Final reports can then be reviewed against the sampling records to ensure that the data presented in the reports represent complete and accurate information. Analytical data will be validated as specified in the Analytical QA Plan.

The Field Survey Lead performing oversight of breeding bird egg collection surveys will validate that Project Scientists and Technicians are correctly identifying the proper species and completing data forms correctly by performing periodic checks during surveys. When possible, data collected at each nest will be validated by photographs of eggs. Because disturbance to nesting individuals is a study concern, and a high level of disturbance could disrupt nesting study species, care will be taken to verify nesting using photographs and videos only when absolutely necessary. The Field Survey Lead will make this determination.

Data analysis will be performed using Statistica® (StatSoft 1999). All numeric data presented in reports will contain basic statistical properties and uncertainty. The robustness of each parameter studied will be presented.

4.0 EQUIPMENT LIST

The following equipment will be used during the breeding bird surveys and egg collection and processing work.

Species Surveys and Egg Collection

- Cover type maps, digital copies of georeferenced aerial photos of the study area
- Work plan
- Cell phone
- Personal identification
- Tax maps with property owner names
- Bird visual and song field guides
- 35 mm automatic camera
- Color print film ASA 200, 24 exposure, several rolls
- White, self adhering labels
- Binoculars, spotting scope
- Mirror and extension pole
- Tree top peeper and video probe systems, and head mounted display system
- Telescoping pole with padded "J" hook
- Extension or rope ladder
- Trimble global positioning system and Pro-XR data logger
- Field notebook, data forms, pencil, and sharpie marker
- Rubber knee and hip boots
- Breeding bird calls tape or CD
- Tape or CD player
- Canoe or motor boat
- Safety equipment: hardhat, climbing rope, safety glasses, leather gloves, nitrile gloves
- Aluminum foil
- Acculab V-600 balance, accurate to 0.1 gm
- Filament tape
- Padded egg carrier
- Flashlight

Egg Processing

- Nitrile gloves
- White self-adhering labels
- Chemically clean jars (4 oz) with TFE cap-liners
- Acculab V-200 balance, weighs to nearest 0.01 gm
- Distilled-deionized water
- Volumeter

- Egg candler
- Kimwipes
- Aluminum foil
- Plastic bags
- Filament tape
- Laboratory balance (to 0.01 g increments)
- Vernier caliper (graduated to 0.01 mm)
- Chemically rinsed scalpel, other solvents or acids for cleaning
- Dust mask and safety glasses
- Graphite pencil and technical pen
- Federal 35 comparator with rounded contacts (graduated to 0.01 mm – estimated to nearest 0.001 mm)
- All lab materials and equipment listed in Appendix 3

5.0 RESULTS

5.1 Breeding Bird Survey Data

Breeding bird survey results for the study areas will be presented in tables, figures and a narrative. Details regarding the timing of surveys, conditions, general habitat features, known levels of PCB contamination in the floodplain and prey species, and breeding bird observations will be presented and discussed in relation to results. Survey results can be compared across habitat types to provide insight to habitat use and possibly preferred habitat. A summary table will include the breeding bird species observed, number of individuals, locations of observations, and habitats at the each survey station. Maps showing the location of survey points in the study area will be produced. Data forms will be appended to draft and final narrative reports.

5.2 Egg Data

Breeding bird egg measurement endpoints (e.g., egg mass and volume, eggshell thickness, and contaminant concentrations) will be presented in tabular format with the appropriate descriptive statistics. The results of the data analysis comparing groups (e.g., regional comparisons) will also be presented in tabular format. For all statistical tests, the results will include the test statistic value, the level of significance (alpha), and the power (beta) of the test. Data and analytical tables will be accompanied by narrative interpretations of the data.

6.0 SCHEDULE

A detailed schedule is included in Appendix 5. Several tasks need to be sequentially performed while others can run a parallel course. Breeding bird surveys are best completed prior to and during the early portion of the nesting season. This period is in the early to mid spring for all six species (Appendix 1). Habitat reconnaissance efforts and landowner contacts will occur from early March to early May (Appendix 5). Egg collection permits from the USFWS and NYSDEC will need to be obtained by early April. Data analysis and report preparation will occur following the conclusion of the field effort and receipt of PCB concentration data for eggs collected during the study. We assume tissue analysis data will be available by September 10, 2002.

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APPENDIX 1

Breeding Bird History Summary

Natural History Summary Information: Spotted Sandpiper, American Woodcock, Belted Kingfisher, American Robin, Red-Winged Blackbird, and Eastern Phoebe

Species	Existing Studies on PCBs	Egg Laying	# Eggs	Hatching	Nesting Habitat	Nesting Density	Nest Location	Frequency of Occurrence in Study Area	Diet	Feeding Habitat
Spotted sandpiper *(Actitis macularia)*	Heinz *et al.* 1984	May 6 - July 26. Incubation 20 - 22 days.	4	Precocial young hatching early June-July.	Edges of ponds, rivers streams, opens of freshwater bodies.	43 pairs per 17.6 acres.	On the ground, depression lined with grass often under shrubs or weeds or tall grass (3 ft)	Common breeder and generally throughout the region.	Flying insects, worms, fish, crustaceans, mollusks, and carrion.	Open margins of freshwater habitat, edges of open water areas.
American woodcock *(Scolopax minor)*	McLane *et al.* 1971, 1976, 1978, 1984	March 24 - June 17 in NY. Most early to mid April. Incubation 19 - 22 days.	4	Precocial young hatching peak late April - early May.	Young forests, old fields, low wet thickets, moist woodlands in early succession near fields and clearings. Often along woodland edge or a break in the forest canopy.	4 - 7 males per mile. 5 - 6 territorial males per 100 acres.	Usually within 300 ft of display area. Under a tree, brush, or weeds. Shallow depression lined with leaves.	Common breeder throughout the region.	Primarily earthworms and some ground dwelling insects.	Young forests, old fields, moist thickets and woods, agricultural fields, often shrub thickets.
Belted kingfisher *(Ceryle alcyon)*	Heinz *et al.* 1984	May 14 - June 6 in MA and May 11 - June 15 in VT. Incubation 23 - 24 days.	6 to 7	Altricial young hatching June or July	High steep banks within 1 mile of aquatic habitat with abundant forage.	1 pair per 1.8 mile sq.	Horizontal burrow 3 - 6 ft. deep, within a vertical bank, often of sandy composition.	Uncommon, but breeding widespread throughout the region.	Fish, crayfish, and other aquatic prey.	Open water bodies, emergent wetlands, large vernal pools, often use ripples of streams. Need perches along watercourse.
American robin *(Turdus migratorius)*	Knupp *et al.* 1976; Okoniewski & Novesky 1993; Stansley & Roscoe 1999; Walker 1977; NYSDEC Necropsy Reports	April 12 - July 25 in MA. March 23 - July 19 in NY. Incubation 12 - 14 days.	3 to 4	Altricial young	Habitat generalist, woodlands, forests, parks, urban areas.	41 pairs per 100 acres in VT.	Conifers for early nesting. White pine, maples, apple trees, shrubs. Often near forest edge or tree fall gap.	Common and widespread.	Cultivated and wild fruits, earthworms, and insects.	Habitat generalist: fields, lawns, woodland edges, farmlands, hedges, urban areas.
Red-winged blackbird *(Agelaius phoeniceus)*	Stickel *et al.* 1984; Eaton and Carr 1991; Kannan *et al.* 1998; Bishop *et al.* 1995	May 10 - June 18 in MA. April 26 - July 9 in NY. Incubation 11 - 13 days.	3 to 4	Altricial young	Marshes, fresh and brackish; riparian habitats; and agricultural lands near wetlands.	16 pairs per 100 acres in marsh. 11 pairs per 100 acres in upland.	Narrow, deep cup of grass, reeds, and weed rootlets attached to emergent vegetation. Sometimes in shrubs or low in trees.	Common and widespread.	Insects, agricultural grains, natural grass and forbe seeds.	Emergent wetlands, pastures, open fields, and agricultural lands.
Eastern phoebe (*Sayornis phoebe*)	NYSDEC Necropsy Reports	Mid-May to Mid-July. April 27 - Aug 15 in MA. April 20 - Aug 4 in NY. Incubation 14 - 16 days.	4 to 5	Altricial young	Open and riparian woodlands, agricultural areas with scattered trees, urban areas forest edges, rocky ravines.	6 nests per 30 acres, 7 pairs per 1000 acres.	On or in a variety of human built structures, beneath bridges, in culverts, and wells. Often renovate old nests.	Common and widespread.	Flying insects and occasionally fruit.	Open woodland habitats, agricultural areas with scattered trees, urban areas with scattered trees.

Additional references: Brooks and Davis 1987; Bull 1974; Case and Hewitt 1963; Chandler 1989; Cromwell 1963; Davis 1982; DeGraaf *et al.* 2001; Ehrlich *et al.* 1988; Ellison 1985; Gregg, 1984; Knupp *et al.* 1977; Liscinsky 1972; Miller and Miller 1948; Nicholson 1978; Owen 1977; Richards 1988; Samson 1979; Sheldon 1971; Stewart and Robbins 1958; Veit and Petersen 1993; Young 1955.

APPENDIX 2

NYSDEC Facilities Available for Egg Processing

NYSDEC Facilities Available for Egg Processing

NYSDEC Saratoga Tree Nursery
2369 Route 50
Saratoga Springs, NY 12866
Telephone: (518) 581-1439

NYSDEC Delmar Wildlife Resource Center
108 Game Farm Road
Delmar, NY 12054

Region 5 - Warrensburg Sub-Office
Upper Hudson Street Extension
P.O. Box 220
Warrensburg, NY 12885-0220
Telephone: (518) 623-1200

APPENDIX 3

Egg Collection Standard Operating Procedure

Protocol for Avian Egg Collection And Removal Of Contents For Contaminants Analysis

INTRODUCTION

Avian eggs are a common sample for contaminants analysis. An accurate analysis depends upon getting the egg contents from the shell to a clean sample jar without introducing other sources of contamination. This protocol, which has been developed and refined by many researchers over the decades, was written for those who have minimal experience. Your first egg should be a practice egg. *It is suggested that all field personnel practice on several pen-raised quail eggs to improve technique. Chicken eggs may be used if quail eggs are not available.*

Materials and Equipment

FIELD:

- ❑ permits
- ❑ field notebook, writing instruments (pencils/pens/permanent markers)
- ❑ padded egg collection boxes (hard-sided container, e.g., Tupperware or tackle box, with foam padding)
- ❑ square pieces of chemically-clean (Appendix A) aluminum foil, sized to wrap around egg – 1 per egg
- ❑ small ziploc bags
- ❑ Acculab V-600 balance, weighs to nearest 0.1 gm
- ❑ labels

LAB:

- ❑ data sheets
- ❑ paper or other towels
- ❑ green scrubby or sponge
- ❑ Acculab V-200 balance, weighs to nearest 0.01 gm
- ❑ calipers
- ❑ three graduated cylinders: 250 ml, 100 ml, 50 ml (all are of sufficient diameter to insert various sized eggs from the study).
- ❑ Chemically-clean jars, 1 per sample
    - ✓ Make sure they are cleaned for the contaminants you are sampling, e.g., I-Chem pesticide/PCBs Series 200 or 300.
    - ✓ Size: 4 oz.
- ❑ chemically-clean stainless steel scalpel blades (No. 21 or No. 22 with No. 4 handles work well)
- ❑ chemically-clean forceps
- ❑ chemically-clean aluminum foil sheets (approximately 30 x 30 cm square), 1 per egg

- sharps container for used blades or disposable scalpels
- ball-tip micrometer

PROCEDURES

FIELD:

- Collected eggs should be whole and not cracked. Collect fresh eggs if possible. Make a notation about the probable stage of the egg as a fresh egg will float in water (Custer *et al.* 1992), or could be collected from unfinished clutches. The best eggs for contaminants analysis are not cracked, since cracking increases variation in percent moisture, and may lead to interference with or contamination of the contents.
- In the field, wrap eggs in rinsed aluminum foil (rinsed side next to the egg). Think of the foil as a second skin, which you are using to keep the eggshell together and the contents inside should the egg be cracked in transit. Label appropriately (e.g. date, species identification, egg sample number, nest number, and collector's initials. Put label and wrapped egg in a hard container with sufficient padding.
- Transport to lab in hard container with sufficient padding.
- Refrigerate eggs until opened, ideally no longer than 48 hrs. Egg processing will be completed on a daily basis as much as practical.

LAB:

- Fill out egg data form (Appendix B); use one per egg.
- If debris is present, rinse egg in cool water while gently scrubbing with green scrubby or sponge. Do not soak the egg.
- Dry and weigh whole egg.
- Take three measurements each of egg length and maximum egg width with calipers. Compute average of three measurements for final width and length measurements.
- Measure total egg volume by water displacement. Use the graduated cylinder method that is closest in diameter to the largest diameter of the egg. Determine the displacement volume of the wire holding apparatus.
- Using a graduated cylinder:
    1. Fill with distilled water. Note the starting volume.
    2. Immerse egg using wire loops (Fig. 1a) until top of egg is just under water surface.
    3. Note the final volume, subtract starting volume and holding apparatus volume, to determine the final egg volume.

- Using an egg immersion chamber:

  Volume computation may be made using an egg immersion chamber. An immersion chamber that is specially designed for smaller eggs can be made using a small syringe, i.e. 10 cc, and using a pipette for the spout. A small paper clip is used to hold the egg for immersion into the chamber.

a. b. c.

Figure 1. Egg immersion chamber, used to determine volume of whole eggs. A: Wire loops used to hold the egg. B: Apparatus set up to drain into beaker on balance. C: Demonstration photograph using ripe tomato as egg. The top bend of the spigot is high enough so that an egg can be completely immersed below it.

- Dry the egg.
- Transfer egg contents to chemically-clean jar using the following procedure:

1. Use nitrile gloves for this part of the procedure. Avoid letting contents run over your hands into the sample jar.
2. Create a catch basin out of the aluminum foil (rinsed side up) by turning edges up and securing the corners. This will catch egg contents in case they spill over the edge of the jar. Use a separate piece of foil for each sample. The foil also is a clean place to place your instruments when they are not in use.
3. Weigh the clean empty jar with lid on, and note this tare weight on data sheet.
4. Place jar in center of aluminum foil, and loosen the lid.
5. Score equator with serrated blade or scalpel blade. Use a new, chemically-clean scalpel blade for each egg. This part takes practice. Cradle the egg in one hand (don't squeeze too tightly!) and gently score while rotating the egg. Many light strokes are preferable to a fewer

deeper strokes, increasing the evenness of the score and decreasing the possibility of eggshells not separating cleanly or of punching through the shell. Continue to work on your score until you see the membrane, which usually appears gray underneath the white of the eggshell. When you see the first bit of membrane, remove the lid from the jar so that it will be ready as soon as you need it. Avoid getting shell dust, or anything else besides the egg contents, in the jar. Try to expose the membrane evenly around the entire egg. Often the score line can be used to help pick the egg shell apart using forceps.

6. Place the egg over the jar and cut through membranes with the scalpel. A new scalpel blade should be used at this point to reduce the potential for cross contamination and since the blade may become dull during the cutting process. The scalpel can also be used to finish scoring down to the membranes. Pour contents into jar, or use the scalpel to gently scrape if that is necessary. Small stainless steel scoops are also available to help remove the contents. Use forceps to remove any shell fragments from the jar. Cover the jar. Photograph the egg contents in the jar with the label visible and the remaining egg shell.
7. Note where the membranes are, as this is important for thickness measurements. For fresh eggs, both membranes often stay with the shell, but as the embryo develops, the inner membrane tends to stick with the chick. If you cannot determine where the membranes are, it often becomes clearer after the eggshell and membranes have dried.
8. For very small eggs, there are two procedures suggested. The first option is to use a small chemically-clean needle or scalpel to pierce a small hole at both ends of the egg. Insert a chemically-clean syringe into the egg to withdraw the contents. Redeposit the contents into the jar and follow the guidelines for storage and measuring the shell thickness. The second option is to use a sharp, non-serrated scalpel and cut around the circumference at one end of the egg. Scoop out the contents with a tiny dry chemical scoop (stainless steel) that is small enough to fit into the egg.
9. Note that addled eggs can be full of decomposition by-products, producing gaseous explosions at any weak point in the shell, including where you start your score or where membranes are first exposed. Working with a refrigerated, cool egg reduces this potential, but be prepared for egg explosions.
10. The target for the minimum weight of egg tissue is 4 grams for analysis. It may be possible to analyze smaller samples ranging from 1 – 2 grams. Analysis of these samples may result in a lower detection limit due to the lack of mass. An effort must be made to maximize the amount of each sample that is usable. The weight of each sample should be made in the laboratory during egg processing using the following procedure:

a. Place a small jar on a balance that reads to at least 1 milligram and that has been appropriately calibrated.
b. Tare the jar or record the jar weight if the balance cannot be tared.
c. Open the egg, according to the procedures referenced above and empty the contents into the jar.
d. Record the weight, to the nearest milligram, of the egg contents if the balance was tared. If the balance was not tared, then record the weight for the egg contents and the jar, then subtract the previously recorded weight of the jar. Record the weight of the egg contents in the field notebook and on the jar label.
e. If egg is developed, estimate age of embryo. Wet weight conversion will be made based on the weight and volume of the egg. A photographic record of the contents of each egg will be made. Documentation of embryo development is very limited (Powell *et al.* 1998; Bird *et al.* 1984), therefore, documenting this phase of the egg processing is important. Note amount of decay or anything else pertinent to your study, and examine for deformities, particularly bill deformities such as crossed bills or lack of jaws, but also lack of skull bones, club feet, rotated ankles, or dwarfed appendages (Gilbertson *et al.* 1991).
f. Repeat these procedures for any other eggs that need to be added to the sample jar. Using these procedures, the weight of each egg's contents will be measured, even for eggs whose contents are combined into a single jar.

✓ Do not touch or move the jar between steps 2 and 4 above. It is preferable to add the egg contents to the jar while the jar is still on the balance, immediately after taring the jar.

❑ Rinse the eggshell halves with cool water and allow to air dry for 10-30 days. Label each egg shell with the species identification code, egg number, and nest number. Store the shell pieces in a labeled plastic bag.
❑ Compute conversion factor, as explained on the data sheet. Contaminant concentrations are multiplied by this conversion factor to get volume-adjusted residue data (Stickel *et al.* 1973).
❑ Place label on jar. Place clear tape over the label to keep it from getting wet.
❑ Prepare Chain of Custody records and maintain egg samples under chain of custody.

- Freeze samples. Ship under Chain of Custody overnight on dry ice to the sample archive or analytical laboratory.
- After eggshells have dried, measure at three points near the equator on each shell half using ball-tip micrometer. If you are comparing to museum specimen thickness measurements, which usually include the membranes, you must either include membranes or make adjustments for the absent membranes. The data sheet (Appendix B) has adjustments for bald eagles – you can use these as approximations or create your own adjustments by measuring shells with and without membranes for comparisons to the study species.

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These egg-processing guidelines were developed by the U.S. Fish and Wildlife Service and modified for the project based on consultation with the author of these guidelines and on conversations with the Quality Assurance Coordinator for this project. For more information, or to suggest additions or clarifications, please contact:

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Appendix A: Chemically-Clean Instruments for Collecting Contaminants Samples

To minimize cross-contamination when collecting biological samples for contaminants analysis, a primary requirement is use of chemically-clean instruments. These are made of appropriate materials (stainless steel or teflon) and rinsed with alcohol and solvents to remove contamination and organics. Once rinsed, the instruments should be treated as sterile instruments, e.g. not placed on unclean surfaces.

Because every laboratory situation is different, this document tells you what to do but not how to do it. The chemicals used for rinsing are hazardous, so you should follow proper safety and laboratory protocols when using them. This includes proper personal protective equipment (lab coats, gloves specific to the chemical, eye protection), proper laboratory equipment and procedures (use of hood, proper storage and disposal methods), and knowledge of chemical hazards such as flammability, reactivity, and toxicity (MSDS required). If this is all new to you, enlist the help of a chemist to help you make the proper decisions and reduce your risks of exposure and accident.

For organics, rinse with a reagent-grade isopropyl alcohol, air-dry, rinse with reagent-grade hexanes, and air-dry.

Aluminum foil can be rinsed with acetone and hexane to remove organics. Air-dry, and then fold cleaned-side in if not using immediately. The cleaned foil can be used to store samples (e.g. very large samples or as a substitute I-Chem jar), provide a clean work surface for dissections, or to wrap cleaned instruments for transport or storage. (The conventional wisdom is to rinse the dull side, as the shiny side has oils on it. The oils will probably wash away with a solvent wash but why bother if you can use the cleaner dull side to start with.)

Rinsing should be done using glass pipettes or wash bottles (made of appropriate material for the rinsing agent). Glass funnels, wide enough to accommodate your instruments and foil sheets, are invaluable in directing the flow of used chemicals into disposal containers or waste jars. Use disposal containers that are the same as your source chemical containers (e.g. brown glass). Never rinse into or pour unused chemicals back into your source chemical bottle.

Appendix B. Data Sheet

Avian Egg Data Sheet

Collector's Name: ________________________ Processor's Name ________________________

Collector's Signature ______________________ Processor's Signature ____________________

Species: ________________________ Photo Roll # __________ Photo Frame # ____________

Date Collected: ________ Date Transferred: _____________ Date Processed: ______________

Nest Number or location:____

Egg Number or description:____

Nest status at time of collection:____
(laying, incubating, abandoned, with chicks - how many, post-fledging, etc.)

Egg Length (three measurements, mm):_______ , _______ , ________ Average _______

Egg Width (three measurements, mm): _______ , _______ , ________ Average _______

Whole Egg Weight (g): _________

Egg Volume: Displaced H_2O: volume (cm^3): __________ OR weight[1] (g): ____________

Contents weight:
- Weight of jar (g) : __________
- Weight of jar + contents (g): __________
- Weight of contents (g): __________

Conversion factor[3] = $\dfrac{\text{contents weight}}{\text{calc. max. egg vol}}$ OR $\dfrac{\text{contents weight}}{\text{displaced } H_2O \text{ vol.}}$ = ______________

Contents condition (age of embryo, state of decay, etc.) and other comments:
____
____

Where are the membranes? Inner: _______________ Outer: _______________________

Eggshell thickness (mm) after > 10 days of air drying:________________
(correction for absent membranes, bald eagles: Inner = 0.03 mm, Outer = 0.13 mm)

First eggshell half: _____ ______ _____ _____ Avg: ______ Corrected: _______
Second eggshell half:_____ ______ _____ _____ Avg: ______ Corrected: _______

Overall Avg: ______ Corrected: _______

Dry shell weight (mg) after > 10 days of air drying: ___________________
Thickness index = weight [mg]/(length)(width)[mm]: _____________

Contaminants disposition (catalog number and date submitted, etc):

---

[1]Assume 1 g H_20 = 1 cm^3 [2] See Stickel et al. 1973. [3] If you have both, use the large

APPENDIX 4

Chain of Custody Form

CHAIN OF CUSTODY RECORD

Fed Ex # ___________________________

Package # ___________________________

Project Name:	Project #:	Container Type (e.g., padded egg carrier, cooler, etc.):
Sampler(s): Printed Name and Signature		

SP-NES-NUM	Date Collected	Time Collected	Location	Jar size (N/A for whole eggs)	Remarks

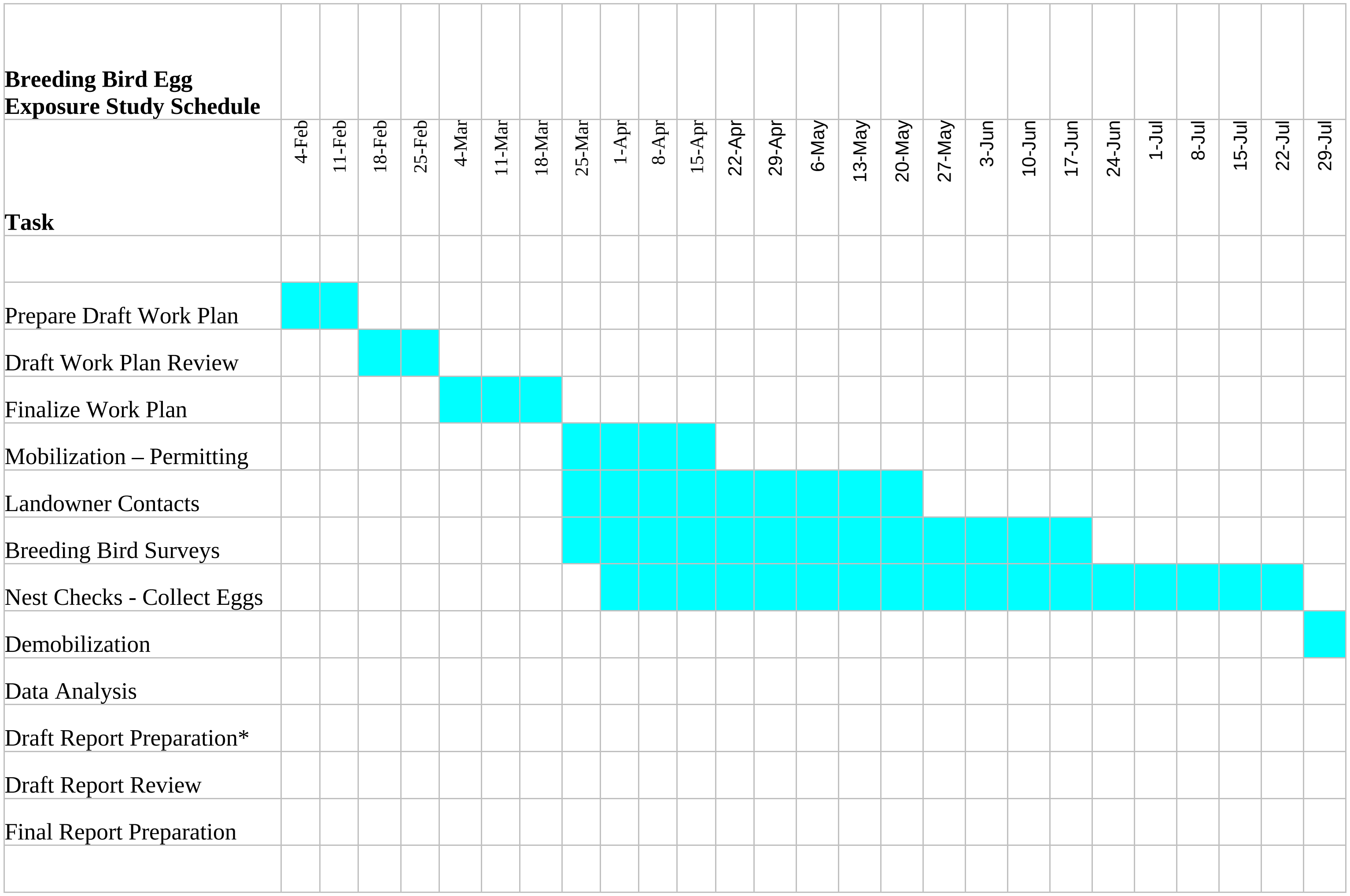
Special Instructions/Comments:

Signature	Print Name	Company/Title	Date	Time
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

CHAIN OF CUSTODY FORM

APPENDIX 5

Schedule



*Assumes validated egg tissue data are available by September 10, 2002.

Breeding Bird Egg Exposure Study Schedule

Task	5-Aug	12-Aug	19-Aug	26-Aug	2-Sep	9-Sep	16-Sep	23-Sep	30-Sep	7-Oct	14-Oct	21-Oct	28-Oct	4-Nov	11-Nov	18-Nov	25-Nov	2-Dec	9-Dec	16-Dec	23-Dec	30-Dec
Prepare Draft Work Plan																						
Draft Work Plan Review																						
Finalize Work Plan																						
Mobilization – Permitting																						
Landowner Contacts																						
Breeding Bird Surveys																						
Nest Checks - Collect Eggs																						
Demobilization																						
Data Analysis																						
Draft Report Preparation*																						
Draft Report Review																						
Final Report Preparation																						

*Assumes validated egg tissue data are available by September 10, 2002.